General

Guideline Title

American Academy of Orthopaedic Surgeons clinical practice guideline on management of carpal tunnel syndrome.

Bibliographic Source(s)

American Academy of Orthopaedic Surgeons (AAOS). American Academy of Orthopaedic Surgeons clinical practice guideline on management of carpal tunnel syndrome. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2016 Feb 29. 983 p. [227 references]

Guideline Status

This is the current release of the guideline.

This guideline updates previous versions:

American Academy of Orthopaedic Surgeons (AAOS). Clinical practice guideline on the treatment of carpal tunnel syndrome. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2008 Sep. 76 p. [116 references]

American Academy of Orthopaedic Surgeons clinical guideline on diagnosis of carpal tunnel syndrome. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2007. 72 p. [381 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Recommendations

Major Recommendations

Definitions of the strength of recommendations (Strong, Moderate, Limited, and Consensus) and Strength Visual (â˜…â˜…â˜…â˜…, â˜…â˜…â˜…â˜…, â˜…â˜…â˜…â˜…, â˜…â˜…â˜…) are provided at the end of the "Major Recommendations" field.

Note from the American Academy of Orthopaedic Surgeons (AAOS): The following is a summary of the recommendations of the AAOS Clinical Practice Guideline on the Management of Carpal Tunnel Syndrome. All readers of this summary are strongly urged to consult the full guideline and evidence report for this information. The AAOS work group is confident that those who read the full guideline and evidence report will see that the recommendations were developed using systematic evidence-based processes designed to combat bias, enhance transparency, and promote reproducibility.

This summary of recommendations is not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient, physician, and other healthcare practitioners.

Summary of Recommendations

Observation

Strong evidence supports thenar atrophy is strongly associated with ruling-in carpal tunnel syndrome (CTS), but poorly associated with ruling-out CTS. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Physical Signs

Strong evidence supports not using the Phalen test, Tinel sign, Flick sign, or Upper limb neurodynamic/nerve tension test (ULNT) criterion A/B as independent physical examination maneuvers to diagnose carpal tunnel syndrome, because alone, each has a poor or weak association with ruling-in or ruling-out CTS. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Maneuvers

Moderate evidence supports not using the following as independent physical examination maneuvers to diagnose CTS, because alone, each has a poor or weak association with ruling-in or ruling-out CTS:

- Carpal compression test
- Reverse Phalen test
- Thenar weakness or thumb abduction weakness or abductor pollicis brevis manual muscle testing
- 2-point discrimination
- Semmes-Weinstein monofilament test
- CTS-relief maneuver (CTS-RM)
- Pin prick sensory deficit; thumb or index or middle finger
- ULNT Criterion C
- Tethered median nerve stress test
- Vibration perception – tuning fork
- Scratch collapse test
- Luthy sign
- Pinwheel

Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

History Interview Topics

Moderate evidence supports not using the following as independent history interview topics to diagnose CTS, because alone, each has a poor or weak association with ruling-in or ruling-out CTS:

- Sex/gender
- Ethnicity
- Bilateral symptoms
- Diabetes mellitus
- Worsening symptoms at night
- Duration of symptoms
- Patient localization of symptoms
- Hand dominance
- Symptomatic limb
- Age
- Body mass index ()

Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Patient Reported Numbness or Pain

Limited evidence supports that patients who do not report frequent numbness or pain might not have CTS. Strength of Recommendation: Limited Evidence â˜…â˜…

Hand-held Nerve Conduction Study (NCS)

Limited evidence supports that a hand-held NCS device might be used for the diagnosis of CTS. Strength of Recommendation: Limited Evidence â˜…â˜…

Magnetic Resonance Imaging (MRI)

Moderate evidence supports not routinely using MRI for the diagnosis of CTS. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Diagnostic Ultrasound

Limited evidence supports not routinely using ultrasound for the diagnosis of CTS. Strength of Recommendation: Limited Evidence â˜…â˜…

Diagnostic Scales

Moderate evidence supports that diagnostic questionnaires and/or electrodiagnostic studies could be used to aid the diagnosis of CTS. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Increased Risk of CTS

A. Strong evidence supports that BMI and high hand/wrist repetition rate are associated with the increased risk of developing CTS. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…
B. Moderate evidence supports that the following factors are associated with the increased risk of developing CTS:
    - Peri-menopausal
    - Wrist ratio/index
    - Rheumatoid arthritis
    - Psychosocial factors
    - Distal upper extremity tendinopathies
    - Gardening
    - American Conference of Governmental Industrial Hygienists Hand Activity Level at or above threshold
    - Assembly line work
    - Computer work
    - Vibration
    - Tendinitis
    - Workplace forceful grip/exertion

    Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

C. Limited evidence supports that the following factors are associated with the increased risk of developing CTS:
    - Dialysis
    - Fibromyalgia
    - Varicosis
    - Distal radius fracture

    Strength of Recommendation: Limited Evidence â˜…â˜…

Decreased Risk of CTS

Moderate evidence supports that physical activity/exercise is associated with the decreased risk of developing CTS. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Factors Showing No Associated Risk of CTS

A. Moderate evidence supports that the use of oral contraception and female hormone replacement therapy (HRT) are not associated with increased or decreased risk of developing CTS. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…
B. Limited evidence supports that race/ethnicity and female education level are not associated with increased or decreased risk of developing CTS. Strength of Recommendation: Limited Evidence â˜…â˜…

Factors Showing Conflicting Risk of CTS

Limited evidence supports that the following factors have conflicting results regarding the development of CTS:

- Diabetes
- Age

- Gender/sex
- Genetics
- Comorbid drug use
- Smoking
- Wrist bending
- Workplace

Strength of Recommendation: Limited Evidence â˜…â˜…

Immobilization

Strong evidence supports that the use of immobilization (brace/splint/orthosis) should improve patient reported outcomes. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Steroid Injections

Strong evidence supports that the use of steroid (methylprednisolone) injection should improve patient reported outcomes. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Magnet Therapy

Strong evidence supports not using magnet therapy for the treatment of CTS. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Oral Treatments

Moderate evidence supports no benefit of oral treatments (diuretic, gabapentin, astaxanthin capsules, non-steroidal anti-inflammatory drugs [NSAIDs], or pyridoxine) compared to placebo. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Oral Steroids

Moderate evidence supports that oral steroids could improve patient reported outcomes as compared to placebo. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Ketoprofen Phonophoresis

Moderate evidence supports that ketoprofen phonophoresis could provide reduction in pain compared to placebo. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Therapeutic Ultrasound

Limited evidence supports that therapeutic ultrasound might be effective compared to placebo. Strength of Recommendation: Limited Evidence â˜…â˜…

Laser Therapy

Limited evidence supports that laser therapy might be effective compared to placebo. Strength of Recommendation: Limited Evidence â˜…â˜…

Surgical Release Location

Strong evidence supports that surgical release of the transverse carpal ligament should relieve symptoms and improve function. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Surgical Release Procedure

Limited evidence supports that if surgery is chosen, a practitioner might consider using endoscopic carpal tunnel release based on possible short term benefits. Strength of Recommendation: Limited Evidence â˜…â˜…

Surgical Versus Nonoperative

Strong evidence supports that surgical treatment of carpal tunnel syndrome should have a greater treatment benefit at 6 and 12 months as compared to splinting, NSAIDs/therapy, and a single steroid injection. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Adjunctive Techniques

Moderate evidence supports that there is no benefit to routine inclusion of the following adjunctive techniques: epineurotomy, neurolysis, flexor tenosynovectomy, and lengthening/reconstruction of the flexor retinaculum (transverse carpal ligament). Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Bilateral Versus Staged Carpal Tunnel Release

Limited evidence supports that simultaneous bilateral or staged endoscopic carpal tunnel release might be performed based on patient and surgeon preference. No evidence meeting the inclusion criteria was found addressing bilateral simultaneous open carpal tunnel release. Strength of Recommendation: Limited Evidence â˜…â˜…

Local Versus Intravenous (IV) Regional Anesthesia

Limited evidence supports the use of local anesthesia rather than IV regional anesthesia (bier block) because it might offer longer pain relief after carpal tunnel release; no evidence meeting the inclusion criteria was found comparing general anesthesia to either regional or local anesthesia for carpal tunnel surgery. Strength of Recommendation: Limited Evidence â˜…â˜…

Buffered Versus Plain Lidocaine

Moderate evidence supports the use of buffered lidocaine rather than plain lidocaine for local anesthesia because it could result in less injection pain. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Aspirin Use

Limited evidence supports that the patient might continue the use of aspirin perioperatively; no evidence meeting the inclusion criteria addressed other anticoagulants. Strength of Recommendation: Limited Evidence â˜…â˜…

Preoperative Antibiotics

Limited evidence supports that there is no benefit for routine use of prophylactic antibiotics prior to carpal tunnel release because there is no demonstrated reduction in postoperative surgical site infection. Strength of Recommendation: Limited Evidence â˜…â˜…

Supervised Versus Home Therapy

Moderate evidence supports no additional benefit to routine supervised therapy over home programs in the immediate postoperative period. No evidence meeting the inclusion criteria was found comparing the potential benefit of exercise versus no exercise after surgery. Strength of Recommendation: Moderate Evidence â˜…â˜…â˜…

Postoperative Immobilization

Strong evidence supports no benefit to routine postoperative immobilization after carpal tunnel release. Strength of Recommendation: Strong Evidence â˜…â˜…â˜…â˜…

Definitions

Strength of Recommendation Descriptions

Strength	Overall Strength of Evidence	Description of Evidence Strength	Strength Visual
Strong	Strong	Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention.	â˜…â˜…â˜…â˜…â˜…
Moderate	Moderate	Evidence from two or more "Moderate" quality studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.	â˜…â˜…â˜…â˜…
Limited	Low Strength Evidence or Conflicting Evidence	Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study for recommending for against the intervention or diagnostic or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.	â˜…â˜…â˜…
Consensus	No Evidence	There is no supporting evidence. In the absence of reliable evidence, the guideline development group is making a recommendation based on their clinical opinion. Consensus statements are published in a separate, complimentary document.	â˜…

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Carpal tunnel syndrome (CTS)

Guideline Category

Diagnosis

Management

Risk Assessment

Treatment

Clinical Specialty

Family Practice

Orthopedic Surgery

Physical Medicine and Rehabilitation

Intended Users

Advanced Practice Nurses

Health Care Providers

Health Plans

Occupational Therapists

Physical Therapists

Physician Assistants

Physicians

Public Health Departments

Guideline Objective(s)

- To help improve treatment based on the current best evidence
- To serve as an information resource for decision makers and developers of practice guidelines and recommendations

Target Population

Adult patients presenting with complaints which may be attributable to carpal tunnel syndrome (CTS)

Interventions and Practices Considered

Diagnosis/Risk Assessment

1. Observation for thenar atrophy
2. Physical signs/maneuvers and history (not recommended to be used alone)
3. Diagnostic questionnaires and/or electrodiagnostic studies
4. Risk assessment based on specific patient factors
5. Hand-held nerve conduction study

Management/Treatment

1. Non-operative treatment (with regular monitoring)
    - Local steroid injection
    - Immobilization (brace/splint/orthosis)
    - Oral steroids
    - Ultrasound
    - Ketoprofen phonophoresis
    - Laser therapy
2. Surgical treatment
    - Release of the transverse carpal ligament
    - Endoscopic carpal tunnel release
    - Simultaneous bilateral or staged endoscopic carpal tunnel release
    - Complete division of flexor retinaculum
    - Local anesthesia
    - Buffered lidocaine
    - Perioperative aspirin

Note: The following were considered but evidence did not support benefit: magnetic resonance imaging (MRI), diagnostic ultrasound, oral treatments (diuretic, gabapentin, astaxanthin capsules, non-steroidal anti-inflammatory drugs [NSAIDs], or pyridoxine), magnet therapy, routine inclusion of adjunctive techniques (epineurotomy, neurolysis, flexor tenosynovectomy, and lengthening/reconstruction of the flexor retinaculum [transverse carpal ligament]), routine use of prophylactic antibiotics prior to carpal tunnel release, routine supervised therapy over home programs in the immediate postoperative period, routine postoperative immobilization after carpal tunnel release.

Major Outcomes Considered

- Incidence and prevalence of carpal tunnel syndrome
- Relief of condition
- Permanent sensory loss
- Functional status
- Quality of life
- Patient satisfaction
- Surgical complications
- Cost

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Study Selection Criteria

The American Academy of Orthopaedic Surgeons (AAOS) developed *a priori* article inclusion criteria for review. These criteria are "rules of evidence" and articles that did not meet them are, for the purposes of this guideline, not evidence.

To be included in the systematic reviews (and hence, in this guideline) an article had to meet the following criteria:

- Study must be of a carpal tunnel syndrome (CTS) injury or prevention thereof
- Study must be published in or after 1966 for *surgical treatment*, *rehabilitation*, *bracing*, *prevention* and *magnetic resonance imaging (MRI)*
- Study must be published in or after 1966 for *x rays* and *non-operative treatment*
- Study must be published in or after 1966 for all others non specified
- Study should have 10 or more patients per group
- For surgical treatment a minimum of 3 months follow up duration
- Antibiotic prophylaxis, anticoagulations, mode of anesthesia: all follow-ups
- For *non-operative* treatment a minimum of 1 month

Standard Criteria for all Clinical Practice Guidelines

- Article must be a full article report of a clinical study.
- Retrospective non-comparative case series, medical records review, meeting abstracts, historical articles, editorials, letters, and commentaries are *excluded*.
- Confounded studies (i.e., studies that give patients the treatment of interest AND another treatment) are *excluded*.
- Case series studies that have non-consecutive enrollment of patients are *excluded*.
- Controlled trials in which patients were not stochastically assigned to groups AND in which there was either a difference in patient characteristics or outcomes at baseline AND where the authors did not statistically adjust for these differences when analyzing the results are *excluded*.
- All studies of "Very Weak" strength of evidence are *excluded*.
- All studies evaluated as Level V will be *excluded*.
- Composite measures or outcomes are *excluded* even if they are patient-oriented.
- Study must appear in a peer-reviewed publication.
- For any included study that uses "paper-and-pencil" outcome measures (e.g., 36-Item Short Form Health Survey [SF-36]), only those outcome measures that have been validated will be included
- For any given follow-up time point in any included study, there must be ≥50% patient follow-up (if the follow-up is >50% but <80%, the study quality will be downgraded by one Level).
- Study must be of humans.
- Study must be published in English.
- Study results must be quantitatively presented.
- Study must not be an in vitro study.
- Study must not be a biomechanical study.
- Study must not have been performed on cadavers.

Surrogate outcomes will only be evaluated when no patient oriented outcomes are available.

Literature Searches

The systematic review began with a comprehensive search of the literature. Articles considered were published prior to February 27, 2015 in four electronic databases: PubMed, EMBASE, CINAHL, and The Cochrane Central Register of Controlled Trials. The medical librarian conducted the search using key terms determined from the guideline development group's preliminary recommendations.

The electronic search was supplemented with a manual search of the bibliographies of all retrieved publications, recent systematic reviews, and other review articles for potentially relevant citations. Recalled articles are evaluated for possible inclusion based on the study selection criteria and are summarized for the guideline development group who assist with reconciling possible errors and omissions.

The study attrition diagram in Appendix IV (see the original guideline document) provides a detailed description of the numbers of identified abstracts and recalled and selected studies that were evaluated in the systematic review of this guideline. The search strategies used to identify the

abstracts are contained in Appendix V in the original guideline document.

Number of Source Documents

230 articles included after full text review and quality analysis (see the Study Attrition Flowchart in Appendix IV of the original guideline document)

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Methods for Evaluating Evidence

The American Academy of Orthopaedic Surgeons (AAOS) judges quality based on *a priori* population, intervention, comparison, and outcome (PICO) questions and use an automated numerical scoring process to arrive at final ratings. Extensive measures are taken to determine quality ratings so that they are free of bias.

The quality of evidence is evaluated separately for each study using modified versions of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) and Quality Assessment of Diagnostic Studies (QUADAS) instruments. Depending on the type of study (i.e., diagnostic, prognostic, randomized control trial, or observational) the study design is evaluated using a list of standardized questions (see below for the domains evaluated for each type of study design).

Diagnostic Study Quality Appraisal Questions

The following questions are used to evaluate the study quality of diagnostic study designs.

1. Was the patient spectrum representative of the patients who will receive the test in practice?
2. Were the selection criteria clearly described?
3. Was the execution of the index and reference tests described in sufficient detail to permit its replication?
4. Is the reference standard likely to correctly classify the target condition?
5. Are the index test(s) results interpreted by an examiner without the knowledge of the reference tests results (or vice versa)?
6. Other bias?

Diagnostic Study Design Quality Key

High Quality Study	<1 Flaw
Moderate Quality Study	≥1 and <2 Flaws
Low Quality Study	≥2 and <3 Flaws
Very Low Quality Study	≥3 Flaws

Prognostic Study Quality Appraisal Questions

The following questions are used to evaluate the study quality of prognostic study designs.

1. Was the spectrum of patients studied for this prognostic variable representative of the patient spectrum seen in actual clinical practice?
2. Was loss to follow up unrelated to key characteristics?
3. Was the prognostic factor of interest adequately measured in the study to limit potential bias?
4. Was the outcome of interest adequately measured in study participants to sufficiently limit bias?
5. Were all important confounders adequately measured in study participants to sufficiently limit potential bias?
6. Was the statistical analysis appropriate for the design of the study, limiting potential for presentation of invalid results?

Prognostic Study Design Quality Key

High Quality Study	<1 Flaw
Moderate Quality Study	≥1 and <2 Flaws
Low Quality Study	≥2 and <3 Flaws
Very Low Quality Study	≥3 Flaws

Randomized Study Quality Appraisal Questions

The following domains are evaluated to determine the study quality of randomized study designs.

1. Random sequence generation
2. Allocation concealment
3. Blinding of participants and personnel
4. Incomplete outcome data
5. Selective reporting
6. Other bias

Upgrading Randomized Study Quality Questions

1. Is there a large magnitude of effect?
2. Influence of all plausible residual confounding
3. Dose-response gradient

Randomized Study Design Quality Key

High Quality Study	<2 Flaws
Moderate Quality Study	≥2 and <4 Flaws
Low Quality Study	≥4 and <6 Flaws
Very Low Quality Study	≥6 Flaws

Observational Study Design Quality Appraisal Questions

The following questions are used to evaluate the study quality of observational study designs. Note that all observation studies begin the appraisal process at "low quality" due to design flaws inherent in observational studies.

1. Is this observational study a prospective case series?
2. Does the strategy for recruiting participants into the study differ across groups?
3. Did the study fail to balance the allocation between the groups or match groups (e.g., through stratification, matching, propensity scores)?
4. Were important confounding variables not taken into account in the design and/or analysis (e.g., through matching, stratification, interaction terms, multivariate analysis, or other statistical adjustment such as instrumental variables)?
5. Was the length of follow-up different across study groups?
6. Other bias?

Upgrading Observational Study Quality Questions

1. Is there a large magnitude of effect?
2. Influence of all plausible residual confounding
3. Dose-response gradient

Observational Study Design Quality Key

High Quality Study	<2 Flaws
Moderate Quality Study	≥2 and <4 Flaws
Low Quality Study	≥4 and <6 Flaws

Very Low Quality Study	≥6 Flaws

Methods Used to Analyze the Evidence

Meta-Analysis of Randomized Controlled Trials

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Best Evidence Synthesis

Only the best available evidence for any given outcome addressing a recommendation was included. Accordingly, first included was the highest quality evidence for any given outcome if it was available. In the absence of two or more occurrences of an outcome at this quality, the authors considered outcomes of the next lowest quality until at least two or more occurrences of an outcome had been acquired. For example, if there were two "moderate" quality occurrences of an outcome that addressed a recommendation, the authors did not include "low" quality occurrences of this outcome. A summary of the evidence that met the inclusion criteria, but was not best available evidence was created and can be viewed by recommendation in Appendix XII in the original guideline document.

Statistical Methods

Analysis of Diagnostic Data

Likelihood ratios (LRs), sensitivity, specificity and 95% confidence intervals were calculated to determine the accuracy of diagnostic modalities based on two by two diagnostic contingency tables extracted from the included studies. When summary values of sensitivity, specificity, or other diagnostic performance measures were reported, estimates of the diagnostic contingency table were used to calculate LRs.

LRs indicate the magnitude of the change in probability of disease due to a given test result. For example, a positive LR of 10 indicates that a positive test result is 10 times more common in patients with disease than in patients without disease. LRs are interpreted according to previously published values, as seen in Table 4 in the original guideline document.

Analysis of Intervention/Prevention Data

When possible, the results were recalculated and reported in individual studies and compiled to answer the recommendations. The results of all statistical analysis conducted by the American Academy of Orthopaedic Surgeons (AAOS) Clinical Practice Guidelines Unit are conducted using SAS 9.4. SAS was used to determine the magnitude, direction, and/or 95% confidence intervals of the treatment effect. For data reported as means (and associated measures of dispersion) the mean difference between groups and the 95% confidence interval was calculated and a two-tailed t-test of independent groups was used to determine statistical significance. When published studies report measures of dispersion other than the standard deviation the value was estimated to facilitate calculation of the treatment effect. In studies that report standard errors or confidence intervals the standard deviation was back-calculated. In some circumstances statistical testing was conducted by the authors and measures of dispersion were not reported. In the absence of measures of dispersion, the results of the statistical analyses conducted by the authors (i.e., the p-value) are considered as evidence. For proportions, the authors report the proportion of patients that experienced an outcome along with the percentage of patients that experienced an outcome. The variance of the arcsine difference was used to determine statistical significance. P-values <0.05 were considered statistically significant.

When the data was available, meta-analyses were performed using the random effects method of DerSimonian and Laird. A minimum of three studies was required for an outcome to be considered by meta-analysis. Heterogeneity was assessed with the I-squared statistic. Meta-analyses with I-squared values less than 50% were considered as evidence. Those with I-squared larger than 50% were not considered as evidence for this guideline. All meta-analyses were performed using SAS 9.4. The arcsine difference was used in meta-analysis of proportions. In order to overcome the difficulty of interpreting the magnitude of the arcsine difference, a summary odds ratio is calculated based on random effects meta-analysis of proportions and the number needed to treat (or harm) is calculated. The standardized mean difference was used for meta-analysis of means and magnitude was interpreted using Cohen's definitions of small, medium, and large effect.

Methods Used to Formulate the Recommendations

Expert Consensus (Nominal Group Technique)

Description of Methods Used to Formulate the Recommendations

This guideline and systematic review were prepared by the American Academy of Orthopaedic Surgeons (AAOS) Management of Carpal Tunnel Syndrome Guideline physician guideline development group (clinical experts) with the assistance of the AAOS Evidence-Based Medicine (EBM) Unit in the Department of Research and Scientific Affairs (methodologists) at the AAOS. To develop this guideline, the guideline development group held an introductory meeting on February 1, 2013 to establish the scope of the guideline and the systematic reviews. As the physician experts, the guideline development group defined the scope of the guideline by creating PICO Questions (i.e., population, intervention, comparison, and outcome) that directed the literature search. When necessary, these clinical experts also provided content help, search terms and additional clarification for the AAOS medical librarian. The medical librarian created and executed the search(s). The supporting group of methodologists (AAOS EBM Unit) reviewed all abstracts, recalled pertinent full-text articles for review and evaluated the quality of studies meeting the inclusion criteria. They also abstracted, analyzed, interpreted, and/or summarized the relevant evidence for each recommendation and prepared the initial draft for the final meeting. Upon completion of the systematic reviews, the physician guideline development group participated in a three-day recommendation meeting on May 15-17, 2015. At this meeting, the physician experts and methodologists evaluated and integrated all material to develop the final recommendations. The final recommendations and rationales were edited, written and voted on at the final meeting. The draft guideline recommendations and rationales received final review by the methodologists to ensure that these recommendations and rationales were consistent with the data. The draft was then completed and submitted for peer review on September 8, 2015.

The resulting draft guidelines were then peer-reviewed, edited in response to that review and subsequently sent for public commentary, whereafter additional edits were made. Thereafter, the draft guideline was sequentially approved by the AAOS Committee on Evidence-Based Quality and Value, AAOS Council on Research and Quality, and the AAOS Board of Directors. All AAOS guidelines are reviewed and updated or retired every five years in accordance with the criteria of the National Guideline Clearinghouse (NGC).

Thus the process of AAOS guideline development incorporates the benefits from clinical physician expertise as well as the statistical knowledge and interpretation of non-conflicted methodologists. The process also includes an extensive review process offering the opportunity for over 200 clinical physician experts to provide input into the draft prior to publication. This process provides a sound basis for minimizing bias, enhancing transparency and ensuring the highest level of accuracy for interpretation of the evidence.

Formulating PICO Questions

The guideline development group began work on this guideline by constructing a set of PICO questions. These questions specify the patient population of interest (P), the intervention of interest (I), the comparisons of interest (C), and the patient-oriented outcomes of interest (O). They function as questions for the systematic review, not as final recommendations or conclusions. Once established, these *a priori* PICO questions cannot be modified until the final guideline development group meeting.

Defining the Strength of the Recommendations

Judging the strength of evidence is only a stepping stone towards arriving at the strength of a guideline recommendation. The strength of recommendation also takes into account the quality, quantity, and the trade-off between the benefits and harms of a treatment, the magnitude of a treatment's effect, and whether there is data on critical outcomes.

Strength of recommendation expresses the degree of confidence one can have in a recommendation. As such, the strength expresses how possible it is that a recommendation will be overturned by future evidence. It is very difficult for future evidence to overturn a recommendation that is based on many high quality randomized controlled trials that show a large effect. It is much more likely that future evidence will overturn recommendations derived from a few small case series. Consequently, recommendations based on the former kind of evidence are given a high strength of recommendation and recommendations based on the latter kind of evidence are given a low strength.

To develop the strength of a recommendation, AAOS staff first assigned a preliminary strength for each recommendation that took only the final strength of evidence (including quality and applicability) and the quantity of evidence (see the "Rating Scheme for the Strength of the Recommendations" field).

Wording of the Final Recommendations

To prevent bias in the way recommendations are worded, the AAOS uses specific predetermined language stems that are governed by the evidence strengths. Each recommendation was written using language that accounts for the final strength of the recommendation.

AAOS Guideline Language Stems

Guideline Language	Strength of Recommendation
Strong evidence supports that the practitioner should/should not do X, because…	Strong
Moderate evidence supports that the practitioner could/could not do X, because…	Moderate
Limited evidence supports that the practitioner might/might not do X, because…	Limited
In the absence of reliable evidence, it is the *opinion* of this work group that…*	Consensus*

*Consensus based recommendations are made according to specific criteria. These criteria can be found in Appendix VII in the original guideline document.

Voting on the Recommendations

The recommendations and their strength were voted on by the guideline development group members during the final meeting. If disagreement between the guideline development group occurred, there was further discussion to see whether the disagreement(s) could be resolved. Recommendations were approved and adopted in instances where a simple majority (60%) of the guideline development group voted to approve.

Rating Scheme for the Strength of the Recommendations

Strength of Recommendation Descriptions

Strength	Overall Strength of Evidence	Description of Evidence Strength	Strength Visual
Strong	Strong	Evidence from two or more "High" quality studies with consistent findings for recommending for or against the intervention.	â˜…â˜…â˜…â˜…â˜…
Moderate	Moderate	Evidence from two or more "Moderate" quality studies with consistent findings, or evidence from a single "High" quality study for recommending for or against the intervention.	â˜…â˜…â˜…â˜†
Limited	Low Strength Evidence or Conflicting Evidence	Evidence from one or more "Low" quality studies with consistent findings or evidence from a single "Moderate" quality study for recommending for against the intervention or diagnostic or the evidence is insufficient or conflicting and does not allow a recommendation for or against the intervention.	â˜…â˜…
Consensus	No Evidence	There is no supporting evidence. In the absence of reliable evidence, the guideline development group is making a recommendation based on their clinical opinion. Consensus statements are published in a separate, complimentary document.	â˜…

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

Peer Review

Following the final meeting, the guideline draft undergoes peer review for additional input from external content experts. Written comments are provided on the structured review form (see Appendix VII in the original guideline document). All peer reviewers are required to disclose their conflicts of interest. To guide who participates, the guideline development group identifies specialty societies at the introductory meeting. *Organizations*, not *individuals*, are specified.

The specialty societies are solicited for nominations of individual peer reviewers approximately six weeks before the final meeting. The peer review period is announced as it approaches and others interested are able to volunteer to review the draft. The chair of the American Academy of Orthopaedic Surgeons (AAOS) Committee on Evidence Based Quality and Value reviews the draft of the guideline prior to dissemination.

Some specialty societies (both orthopaedic and non-orthopaedic) ask their evidence-based practice (EBP) committee to provide review of the guideline. The organization is responsible for coordinating the distribution of materials and consolidating their comments onto one form. The chair of the external EBP committees provides disclosure of their conflicts of interest (COI) and manages the potential conflicts of their members.

Again, the AAOS asks for comments to be assembled into a single response form by the specialty society and for the individual submitting the review to provide disclosure of potentially conflicting interests. The peer review stage gives external stakeholders an opportunity to provide evidence-based direction for modifications that they believe have been overlooked. Since the draft is subject to revisions until its approval by the AAOS Board of Directors as the final step in the guideline development process, confidentiality of all working drafts is essential.

The manager of the evidence-based medicine unit drafts the initial responses to comments that address methodology. These responses are then reviewed by the guideline development group chair and vice-chair, who respond to questions concerning clinical practice and techniques. The director of the Department of Research and Scientific Affairs provides input as well. All comments received and the initial drafts of the responses are also reviewed by all members of the guideline development group. All changes to a recommendation as a result of peer review are based on the evidence and undergoes majority vote by the guideline development group members via teleconference. Final revisions are summarized in a detailed report that is made part of the guideline document throughout the remainder of the review and approval processes.

The AAOS believes in the importance of demonstrating responsiveness to input received during the peer review process and welcomes the critiques of external specialty societies. Following final approval of the guideline, all individual responses are posted on the AAOS Web site with a point-by-point reply to each non-editorial comment. Reviewers who wish to remain anonymous notify the AAOS to have their names de-identified; their comments, the authors' responses, and their COI disclosures are still posted.

Review of the Management of Carpal Tunnel Syndrome guideline was requested of 18 organizations. Seven returned comments on the structured review form (see Appendix IX in the original guideline document).

Public Commentary

After modifying the draft in response to peer review, the guideline was subjected to a thirty day period of "Public Commentary." Commentators consist of members of the AAOS, members of the Council on Research and Quality, members of the Board of Councilors, and members of the Board of Specialty Societies. The guideline is automatically forwarded to the AAOS Board of Directors and Council on Research and Quality so that they may review it and provide comment prior to being asked to approve the document. Members of the Board of Councilors and Board of Specialty Societies are solicited for interest. If they request to see the document, it is forwarded to them for comment. Based on these bodies, over 200 commentators have the opportunity to provide input into this guideline. Three members returned public comments.

The AAOS Guideline Approval Process

This final guideline draft must be approved by the AAOS Committee on Evidence Based Quality and Value Committee, the AAOS Council on Research and Quality, and the AAOS Board of Directors. These decision-making bodies are described in Appendix II in the original guideline document and are not designated to modify the contents. Their charge is to approve or reject its publication by majority vote.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is stated for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

The main benefit of a guideline focused on diagnosis is the emphasis on standardized diagnostic criteria which reduce variability in the case

definition for carpal tunnel syndrome (CTS). This could have an important impact on the care of CTS, by minimizing the risk of incorrect diagnosis, and also help in the design of studies seeking to identify associations with specific workplace exposures, an area of interest for workers.

The benefits of treatment recommendations include decreased variability of care, relief of pain, and improvement in function.

Refer to the original guideline document for benefits of specific interventions.

Potential Harms

- The user should be aware of the limitations and specific utility of hand-held nerve conduction study (NCS) devices. They should not be used in patients that have symptoms or signs that might suggest an alternative diagnosis or in patients who have weakness or atrophy. Use of the hand-held NCS device in those with alternative diagnosis to carpal tunnel syndrome (CTS) or motor deficit may result in missed or delayed diagnosis.
- While diagnostic scales/questionnaires can be used for the clinical assessment of CTS, they may be unable to exclude other etiologies that could mimic CTS (such as cervical radiculopathy), or identify other disorders (such as polyneuropathy) that may affect the decision making process regarding therapy. Where indicated, appropriate clinical evaluation for alternative diagnoses should be carried out. Electrodiagnostic testing may be of most value when the clinical diagnosis is unclear or when atypical features exist.
- There is potential harm of corticosteroid injection in the vicinity of flexor tendons and neurovascular structures.
- The risks associated with surgical release are those of a small outpatient operative procedure.
- The main concern with the local infiltration of anesthetic agents is the well-documented cardiotoxicity of bupivacaine.
- There is a potential risk of bleeding in patients who undergo surgical procedures while on anticoagulants.
- Routine use of prophylactic antibiotics is not without consequence. Financial cost, anaphylaxis, development of antibiotic resistance, and changes in microbiome population are all factors.

Qualifying Statements

Qualifying Statements

- This Clinical Practice Guideline was developed by an American Academy of Orthopaedic Surgeons (AAOS) physician volunteer guideline development group based on a systematic review of the current scientific and clinical information and accepted approaches to treatment and/or diagnosis. This Clinical Practice Guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment should always be based on a clinician's independent medical judgment, given the individual patient's clinical circumstances.
- This summary of recommendations is not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient, physician, and other healthcare practitioners.
- Some drugs or medical devices referenced or described in this Clinical Practice Guideline may not have been cleared by the U.S. Food and Drug Administration (FDA) or may have been cleared for a specific use only. The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or device he or she wishes to use in clinical practice.
- Musculoskeletal care is provided in many different settings by many different providers. The authors created this guideline as an educational tool to guide qualified physicians through a series of treatment decisions in an effort to improve the quality and efficiency of care. This guideline should not be construed as including all proper methods of care or excluding methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific procedure or treatment must be made in light of all circumstances presented by the patient and the needs and resources particular to the locality or institution.

Implementation of the Guideline

Description of Implementation Strategy

Guideline Dissemination Plans

The primary purpose of the present document is to provide interested readers with full documentation about not only the recommendations, but also about how the authors arrived at those recommendations.

Shorter versions of the guideline are available in other venues. Publication of most guidelines is announced by an Academy press release, articles authored by the guideline development group and published in the *Journal of the American Academy of Orthopaedic Surgeons*, and articles published in *AAOS Now*. Most guidelines are also distributed at the American Academy of Orthopaedic Surgeons (AAOS) Annual Meeting in various venues such as on Academy Row and at Committee Scientific Exhibits.

Selected guidelines are disseminated by webinar, an Online Module for the Orthopaedic Knowledge Online Web site, Radio Media Tours, Media Briefings, and by distributing them at relevant Continuing Medical Education (CME) courses and at the AAOS Resource Center.

Other dissemination efforts outside of the AAOS will include submitting the guideline to the National Guideline Clearinghouse (NGC), the Guidelines International Network library, and distributing the guideline at other medical specialty societies' meetings.

Implementation Tools

Mobile Device Resources

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

Living with Illness

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

Bibliographic Source(s)

American Academy of Orthopaedic Surgeons (AAOS). American Academy of Orthopaedic Surgeons clinical practice guideline on management of carpal tunnel syndrome. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2016 Feb 29. 983 p. [227 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2016 Feb 29

Guideline Developer(s)

American Academy of Orthopaedic Surgeons - Medical Specialty Society

Source(s) of Funding

This Clinical Practice Guideline was funded exclusively by the American Academy of Orthopaedic Surgeons (AAOS) who received no funding from outside commercial sources to support the development of this document.

Guideline Committee

Guideline Development Group

Composition of Group That Authored the Guideline

Work Group: Brent Graham, MD, MSc, FRCSC (*Chair*), American Society for Surgery of the Hand, Toronto Western Hospital, Toronto, Ontario; Allan E. Peljovich, MD, MPH (*Vice-Chair*), American Academy of Orthopaedic Surgeons, The Hand & Upper Extremity Center of Georgia, P.C., Atlanta, GA; Robert Afra, MD, American Academy of Orthopaedic Surgeons, American Orthopaedics and Sports Medicine, Encinitas, CA; Mickey S. Cho, MD, American Academy of Orthopaedic Surgeons, Dept. of Orthopaedic Surgery & Rehabilitation, San Antonio Military Medical Center, Ft Sam Houston, TX; Rob Gray, MD, American Academy of Orthopaedic Surgeons, North-Shore University HealthCare System, Skokie, IL; John Stephenson, MD, American Academy of Orthopaedic Surgeons, University of Arkansas for Medical Sciences Department of Orthopaedic Surgery, Little Rock, AR; Andrew Gurman, MD, American Medical Association, Altoona Hand and Wrist Surgery, LLC, Altoona, PA; Joy MacDermid, PhD, American Society of Hand Therapist, Hand and Upper Limb Centre, St. Joseph's Health Centre, London, Ontario; Gary Mlady, MD, American College of Radiology, Department of Radiology, University of New Mexico, Albuquerque, NM; Atul T. Patel, MD, American Academy for Physical Medicine and Rehabilitation, Kansas City Bone & Joint Clinic, P.A., Overland Park, KS; David Rempel, MD, MPH, American College of Occupational and Environmental Medicine, University of California, Richmond, CA; Tamara D. Rozental, MD, American Society for Surgery of the Hand, Beth Israel Deaconess Medical Center, Department of Orthopaedic Surgery, Boston, MA; Mohammad Kian Salajegheh, MD, American Academy of Neurology, Department of Neurology, Brigham and Women's Hospital, Boston, MA

Guidelines Oversight Chair: Michael Warren Keith, MD

AAOS Clinical Practice Guidelines Section Leader: Kevin Shea, MD

AAOS Council on Research and Quality Chair: Kevin J. Bozic, MD, MBA

Financial Disclosures/Conflicts of Interest

In accordance with American Academy of Orthopaedic Surgeons (AAOS) policy, all individuals whose names appear as authors or contributors to Clinical Practice Guideline filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this Clinical Practice Guidelines.

Applicants with financial conflicts of interest (COI) related to the guideline topic cannot participate if the conflict occurred within one year of the start date of the guideline's development or if an immediate family member has, or has had, a relevant financial conflict. Additionally, all guideline development group members sign an attestation form agreeing to remain free of relevant financial conflicts for one year following the publication of the guideline.

See Appendix IX in the original guideline document for individual work group members' conflicts of interest.

Guideline Endorser(s)

American College of Radiology - Medical Specialty Society

American College of Surgeons - Medical Specialty Society

American Society for Surgery of the Hand - Medical Specialty Society

American Society of Plastic Surgeons - Medical Specialty Society

Guideline Status

This is the current release of the guideline.

This guideline updates previous versions:

American Academy of Orthopaedic Surgeons (AAOS). Clinical practice guideline on the treatment of carpal tunnel syndrome. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2008 Sep. 76 p. [116 references]

American Academy of Orthopaedic Surgeons clinical guideline on diagnosis of carpal tunnel syndrome. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2007. 72 p. [381 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Available from the OrthoGuidelines Web site .

All AAOS clinical practice guidelines can be accessed through the AAOS OrthoGuidelines mobile app available from the OrthoGuidelines Web site .

Availability of Companion Documents

None available

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on December 26, 2008. The information was verified by the guideline developer on January 15, 2009. The currency of the guideline was reaffirmed by the developer in 2011 and updated by ECRI Institute on February 20, 2012. This summary was updated by ECRI Institute on June 14, 2016. The updated information was verified by the guideline developer on June 24, 2016.

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